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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

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In the Matter of	)	
Rulemaking to Amend Parts 1, 2, 21 and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services	)	CC Docket No. 92-297
and	)	
Suite 12 Group Petition for Pioneer's Preference	)	PP-22

COMMENTS OF ANDREW CORPORATION

Andrew Corporation ("Andrew"), by its undersigned counsel, hereby submits these comments on the Commission's Third Notice of Proposed Rulemaking ("Notice") and Supplemental Tentative Decision[1] to establish Local Multipoint Distribution Service ("LMDS") in the 27.5-29.5 GHz ("28 GHz") frequency band.

I. INTRODUCTION AND STATEMENT OF INTEREST

Andrew Corporation, founded in 1937, is a globally-recognized U.S. manufacturer of a wide variety of high-quality telecommunications equipment to over 6,000 customers in the

[1] *Third Notice of Proposed Rulemaking and Supplemental Tentative Decision,* CC Docket No. 92-297, PP-22 (released July 28, 1995)("Notice").

United States and in various foreign countries. Andrew has been a pioneer in the area of antenna designs, developing high-quality, innovative and cost-efficient designs to satisfy various customer demands. As a member of the Commission's 28 GHz Negotiated Rulemaking Committee, Andrew is intimately familiar with the Commission's desire to authorize both LMDS and Fixed Satellite Service ("FSS") systems to operate in the 28 GHz frequency band, and to accommodate feeder links for certain Mobile Satellite Service ("MSS") systems in the 28 GHz band.[2]

Andrew shares the Commission's enthusiasm for the rapid dissemination of innovative communications services such as LMDS, FSS and MSS. However, because Andrew is not intimately familiar with the details of the various proposed satellite systems, it is not in a position to assess the viability of the Commission's band segmentation proposal. As an innovator and designer of antennas, however, Andrew has designed an antenna product that will reduce the levels of radiation and possibly facilitate sharing of the 28 GHz band by terrestrial and satellite services. Accordingly, Andrew invites the Commission, LMDS proponents and satellite proponents to examine the technical characteristics of the SHX-type conical horn reflector antenna discussed in Exhibits 1 and 2, and assess whether the reduction in radiation levels will enhance the technical feasibility of LMDS, FSS and MSS systems peacefully coexisting in the 28 GHz band.

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[2] Notice at ¶ 1.

II. THE COMMISSION SHOULD ENCOURAGE ALL PARTIES TO THIS PROCEEDING TO EVALUATE THE FEASIBILITY OF TERRESTRIAL AND SATELLITE SERVICES SHARING THE 28 GHZ BAND IN LIGHT OF ANDREW'S NEWLY DEVELOPED SHX 10 TYPE ANTENNA

As discussed in the Exhibits accompanying these comments, Andrew believes that by constructing an antenna in the form of an absorbed line conical cornucopia, which is also known as a conical horn reflector antenna, the wide-angle radiation from a prime-fed parabolic reflector antenna and the associated electromagnetic interference ("EMI") it produces can be substantially reduced.[3/] Consistent with this view, Andrew has been working on a prototype SHX-type conical horn reflector antenna for the 28 GHz band

As demonstrated in Exhibit 1, the radiation pattern envelopes ("RPEs") produced by the SHX-type antenna will emit substantially lower levels of radiation than any antenna currently available for use by LMDS, FSS, or MSS service providers. Exhibit 1 compares the RPEs of the SHX 10 type conical horn reflector antenna when scaled to a one inch aperture diameter at 28 GHz with the RPEs of the TST antenna mask and to a standard parabolic dish antenna. Based on the early RPEs for the prototype antenna, Andrew believes that a complete set of RPE measurements (both far and near field) will reveal extremely low levels of both far and near-field EMI that would facilitate terrestrial and satellite uses of the 28 GHz band.

III. CONCLUSION

Andrew does not oppose or support the Commission's proposed band segmentation plan. Andrew believes that the SHX 10 type conical horn reflector antenna may provide EMI low

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[3/] *See* Exhibit 2. Exhibit 2 contains a paper by Andrew's Chief Scientist, describing the superior RPE and low EMI characteristics of the SHX type antenna.

enough to allow LMDS, FSS, and MSS services to share the 28 GHz band. Accordingly, Andrew urges the Commission, LMDS proponents and satellite proponents to evaluate the feasibility of terrestrial and satellite services sharing the 28 GHz in light of Andrew's prototype SHX-type antenna.

Respectfully submitted,

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Dated: September 7, 1995

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EXHIBIT 1

RPEs of TST Mask, Standard Parabolic Dish

And SHX Type Antenna at 28 GHz

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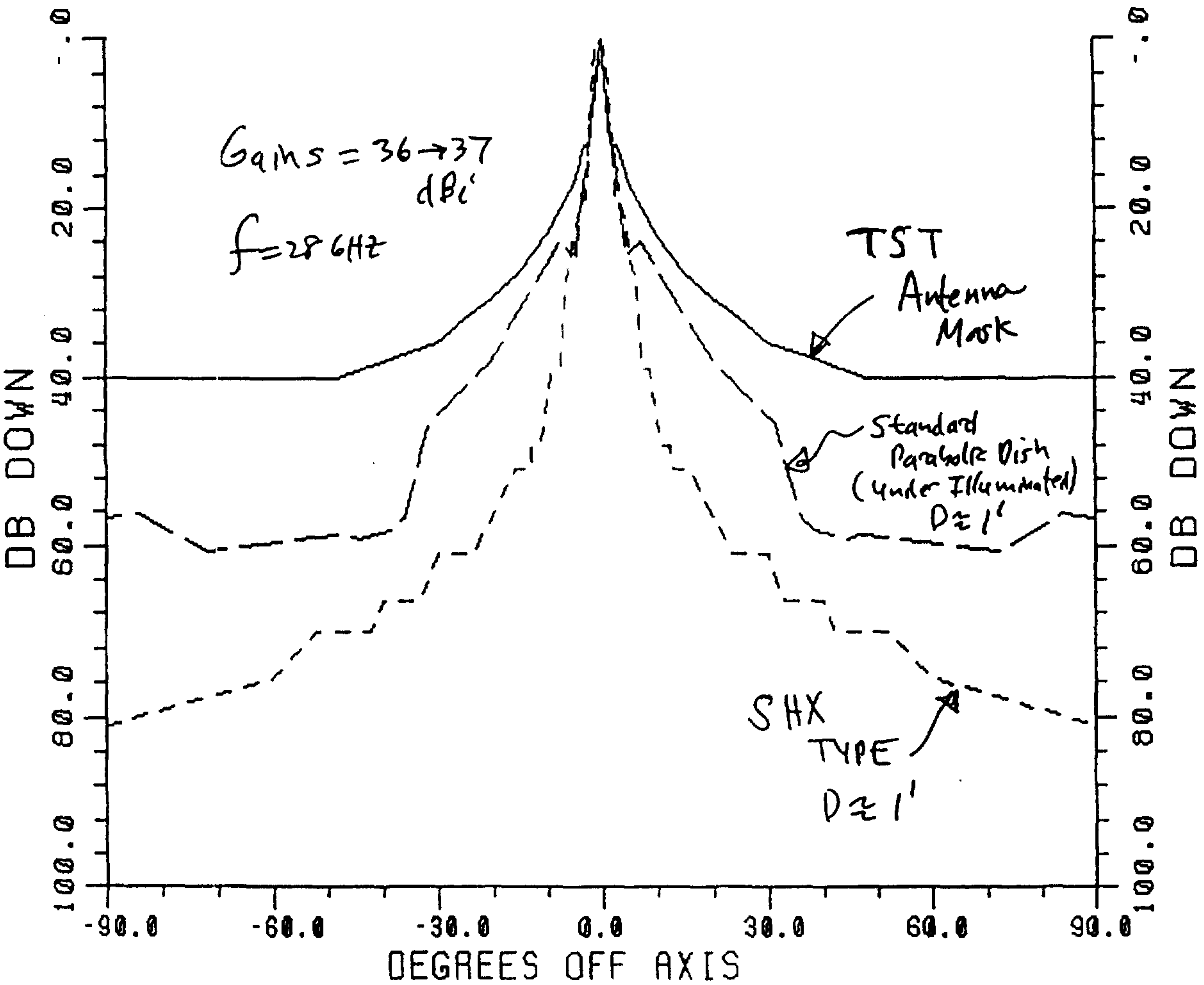

Fig. 1 RPEs+ of ANDREW ANTENAS COMPARED WITH TST ANTENNA MASK

+ Far-Field

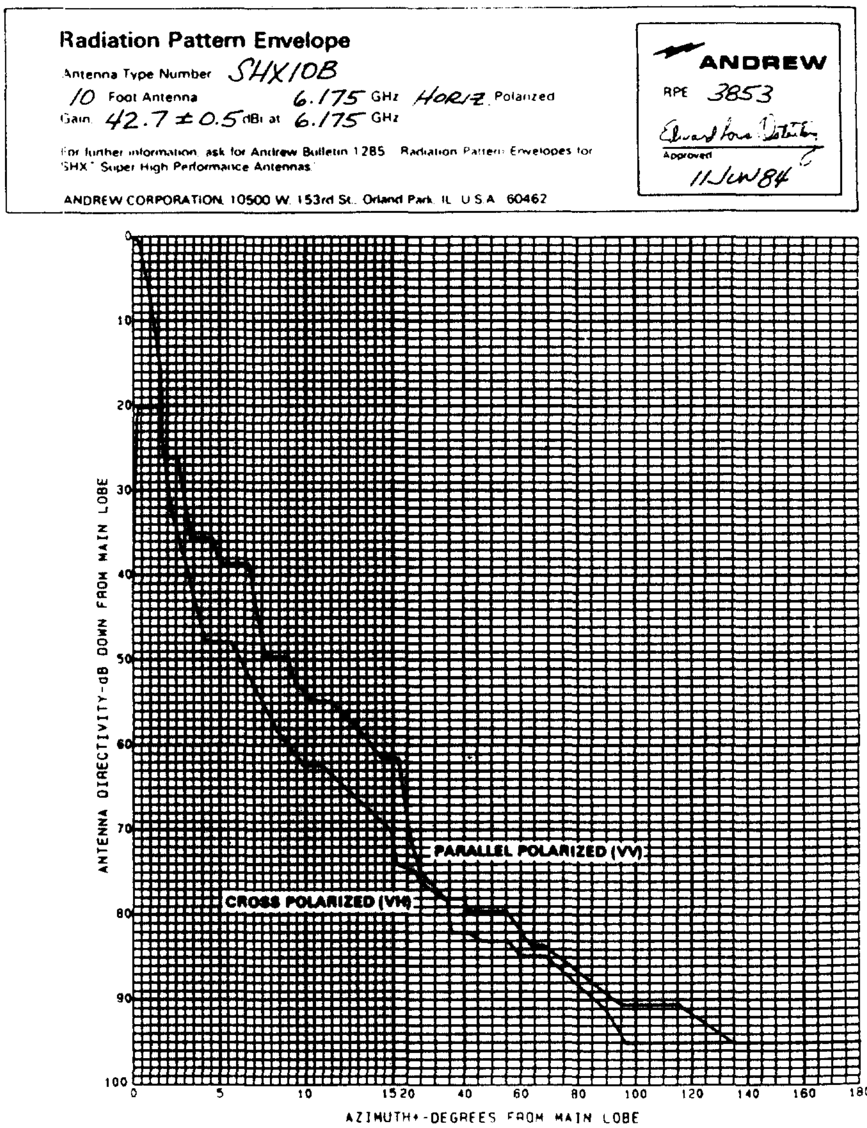

FIGURE 8.8. Radiation pattern envelope of a 3 m horn-parabola antenna Type SHX10B at 6.175 GHz. (Courtesy Andrew Corporation © 1984.)

FIGURE 8.7. Horn-reflector antennas, SHX™ super high performance antennas. (Photo courtesy of Andrew Corporation, © 1982.)

EXHIBIT 2

Copy of EMC Paper on SHX Antenna.

On the Use of a Conical Cornucopia Antenna to Reduce EMI

Charles M. Knop., *Fellow, IEEE*

***Abstract*—The wide-angle radiation from a prime-fed parabolic reflector antenna and the associated EMI it produces can be greatly reduced by constructing the antenna in the form of an absorber-lined conical cornucopia (CC). Typical measured extents of the reduction in wide-angle radiation are reported here and exceed 40 dB relative to a standard symmetrical prime-fed parabolic antenna of the same gain.**

Manuscript received July 19, 1989; revised August 9, 1990.
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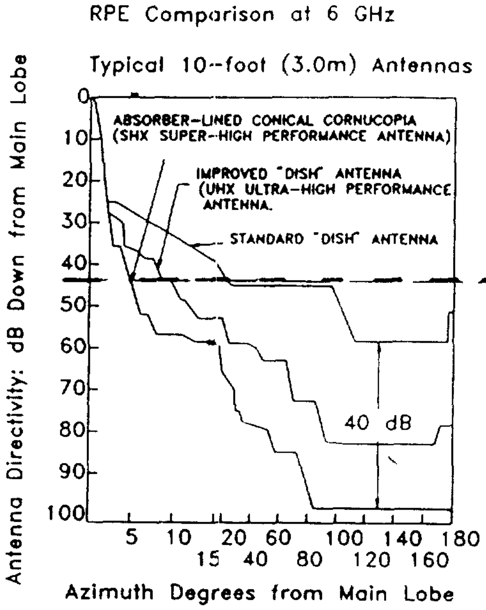

Fig. 1. Measured radiation pattern envelopes (RPE's) of standard dish, improved dish, and conical cornucopia (CC) antennas (10-ft diameters, 6 GHz, 43 dBi gain).

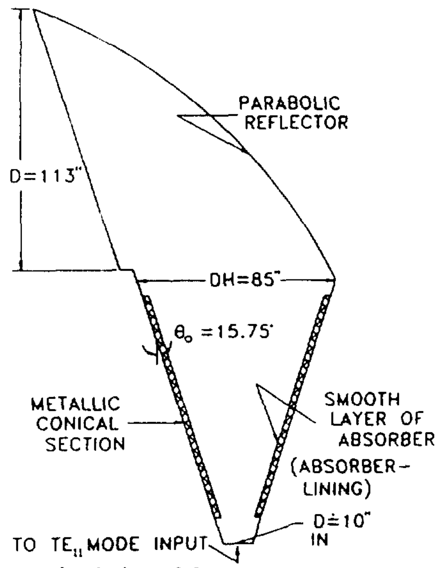

Fig. 2. Cross-sectional view of CC having absorber-lined conical section (with dimensions given for CC having RPE shown in Fig. 1).

I. Introduction

In a previous paper [1], it was shown how a mechanically symmetrical parabolic "dish" having a simple feed and no shield, hereafter referred to as a standard "dish" antenna, can have its wide angle radiation (WAR) reduced by using a corrugated-type feed horn, with its lower dish spillover, and by placing an absorber-lined cylindrical shield on the dish periphery to absorb much of the remaining spillover. Thus, for example, the radiation pattern envelope (RPE), which is approximately the envelope obtained by connecting the sidelobe peaks (of either the E or of the H plane, whichever is greater) of a standard parabolic "dish" is typified by that of Fig. 1. Using corrugations to improve the feed and adding an absorber-lined shield [1], giving the "dish" referred to commercially as a UHX or UMX type, then results in an improved WAR-RPE, as is also shown in Fig. 1.

II. The Conical Cornucopia

Around 1963, the conical cornucopia (CC), which is also known as the conical horn reflector antenna, was analyzed/designed by Hines *et al.* [2] for use as a low noise/broadband communication satellite receiving antenna on Project Echo and Telstar. It is a conical version of the pyramidal horn reflector [3], [4], the latter having found extensive use in the terrestrial microwave radio-relay Bell networks since about 1948. The geometry of a conventional CC [2] is as shown in Fig. 2 (but without the absorber-lining) and consists of a vertical-feed conical section illuminating a parabolic reflector arranged to reflect this illumination horizontally. The antenna is, then, a 90° parabolic-offset antenna with the conical feed extending all the way up to the intersecting parabola. The formed-intersecting cylindrical section is also metallically enclosed and is typically internally lined with pyramidal absorber to "absorb" the spillover energy of the conical horn. These so-formed enclosures greatly reduce the WAR. However, since the field configuration in the vertical conical section is essentially, a circular waveguide TE_{11}-type mode propagating up the cone, its E-plane edge taper is only 4 dB (contrasted with the H plane's infinite edge taper), causing the wide-angle sidelobes of the E-plane radiation pattern to be quite high relative to that in the H plane.

This problem was overcome around 1983 [5] by making the conical section behave like a corrugated horn, as accomplished by appropriately lining the inner walls of the metallic cone with a smooth layer of absorber material, as is depicted in Fig. 2. The analytical details of this behavior are given in [5]–[7], and the physical details of the lining construction/placement are given in [5] and [6]. This lining causes the E-plane taper to approach that of the H plane over a very wide continuous bandwidth (over 3:1) with negligible ohmic loss.[1] This E-plane field tapering action is seen from the measured E-plane power distributions of Fig. 3 over the 4-, 6-, and 11-GHz bands, which also show the negligible effect the absorber lining has on the H-plane fields. These measurements were made at the top of the $\theta_0 = 15.75$ half-angle cone, at a $DH = 85''$ diameter, for the subject $D = 113''$ circular-projected antenna aperture. Note in particular that the 4-dB edge-taper E-plane distribution with no absorber lining becomes a highly tapered distribution with the absorber lining present , as is shown in Fig. 3(b). This lining then causes the antenna to produce an E-plane radiation pattern that is virtually identical to the H-plane radiation pattern with its low wide-angle sidelobes. The absorber lining has virtually no effect on the H-plane radiation pattern. This then gives a CC antenna having a body-of-revolution type pattern with an extremely low WAR RPE, as is also shown in Fig. 1 (and designated there as an SHX type). The ohmic loss introduced by the absorber lining is small (typically less than 0.5 dB) because of the highly tapered fields at the conical wall.

III. Conclusions

It is seen by inspecting the measured RPE's of Fig. 1 (where all antennas have about a 10-ft diameter and 43-dBi gain at 6 GHz and typify the type of WAR-RPE improvement achievable if scaled to other bands/sizes) that the CC's-RPE's for angles from about 10 full half-power beamwidths (here 10°) and beyond, and most especially from about 30 full half-power beamwidths (here 30°) and beyond, are vastly superior to those of either the standard or improved (UHX/UMX) parabolic "dishes." Indeed, it is seen that the CC's-RPE levels are about 95 dB down from on axis for angles greater than about 90°. In other words, the CC's wide-angle RPE is about 40 dB lower than that of a standard parabolic-dish antenna of the same gain, as shown. These very low WAR levels then greatly mitigate the EMI to adjacent microwave routes in terrestrial radio relay applications. As such, absorber-lined CC's are now used extensively in congested-city-entry areas in preference to pyramidal cornucopias.

[1] It is stressed that the behavior of the absorber lining in the conical section is such that it tapers the transverse E-plane fields as they propagate up the cone while having negligible effect on the transverse H-plane fields [6]. This is achieved by the surface impedance that the absorber lining produces and not by an absorption phenomenon (as is the case for the absorber-lined cylindrical shield used to "absorb" spillover energy).

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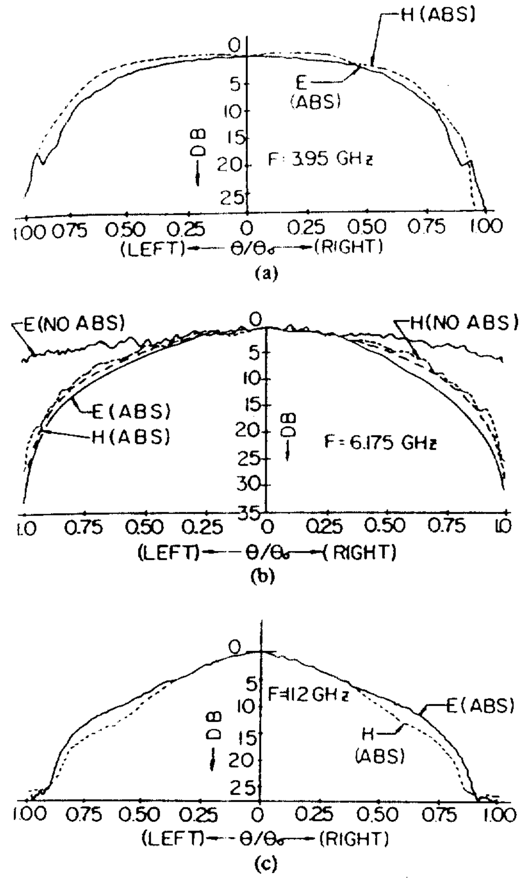

Fig. 3. Measured E- and H-plane aperture distributions at top diameter of conical section ($DH = 85.5''$, $\theta_0 = 15.75°$): (a) 3.95 GHz absorber-lined wall; (b) 6.175 GHz absorber-lined wall and smooth metal wall; (c) 11.20 GHz absorber-lined wall.

More recently, because of the significant EMI reduction achieved by these low WAR levels, CC's of the above types are now gradually being incorporated into military radar/ECM/communication systems and are also being studied for possible use in high-power microwave (HPM) systems to reduce/eliminate EMI and the potential patricide problem. Special designs for many of these applications can be made to occupy small volumes and to meet various gain/bandwidth requirements.

References

[1] C. M. Knop and Y. B. Cheng, "A note on the mitigation of EMI caused by wide-angle radiation from parabolic-dish antennas," *IEEE Trans. Electromagn. Compat.*, vol. 30, no. 4, pp. 583–586, Nov. 1988.

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[4] A. B. Crawford, D. C. Hogg, and L. E. Hunt, "A horn reflector for space communication," *Bell Syst. Tech. J.*, vol. 40, pp. 1095–1116, July 1961 (see also A. W. Love, Electromagnetic Horn Antennas. New York: IEEE Press, 1976, pp. 400–421).

[5] U.S. Patent 4 410 892, Oct. 18, 1983.

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